Two New Species of Deep-Water Corallimorpharia (Cnidaria: Anthozoa) from the Northeast Pacific, *Corallimorphus denhartogi* and *C. pilatus*[1]

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Abstract: Corallimorpharia is currently considered an order of hexacorallian anthozoans. Being skeletonless, its members are sometimes referred to as sea anemones, but they are morphologically more similar to members of Scleractinia than to members of Actiniaria. We describe two new species of corallimorpharians from deep water off the west coast of North America as *Corallimorphus denhartogi*, n. sp. and *Corallimorphus pilatus*, n. sp. The former occurs at depths of 2550–4300 m from Oregon to Baja California, and the latter at depths of 198–900 m from British Columbia to southernmost California. The average size of individuals of *C. denhartogi* is greater than that of *C. pilatus*, and tentacles of the latter are more densely arrayed and relatively longer than those of the former. The distribution and sizes of their cnidae distinguish them from one another as well as from their four congeners, which are widely distributed in the world's oceans. In the collections we examined, specimens of *C. denhartogi* are more common than those of *C. pilatus*.

CORALLIMORPHARIA IS CURRENTLY considered an order of hexacorallian anthozoans. Its members are skeletonless, and so are sometimes referred to as sea anemones, but are characterized by anatomy and nematocysts that more closely ally them with "true" or "stony" corals (order Scleractinia) than with anemones sensu stricto (order Actiniaria) (e.g., den Hartog 1980, Fautin et al. 1999, Romano and Cairns 2000). The corallimorpharian species *Corynactis californica* Carlgren, 1936, is well documented in shallow Northeast Pacific waters from British Columbia to Baja California (e.g., Harbo 1999). Corallimorpharians from deep waters of the Northeast Pacific are common in museum collections but have not been identified beyond genus *Corallimorphus* (e.g., Fautin et al. 1987); we have found that they belong to two species, both new to science.

We identify as *Corallimorphus denhartogi*, n. sp. (Figure 1) 508 specimens taken at 2550–4300 m from Oregon to Baja California. Superficially they can be divided into two groups based on column height and form, but in all taxonomically important respects, members of the two groups are indistinguishable, and individuals of both types were collected together. They have relatively short tentacles and none of the specimens we examined exceeds 70 mm in oral or pedal disk diameter. Thirty-four specimens we identify as *Corallimorphus pilatus*, n. sp. (Figure 2) were taken at 198–900 m from British Columbia to the vicinity of La Jolla, California. Consider-

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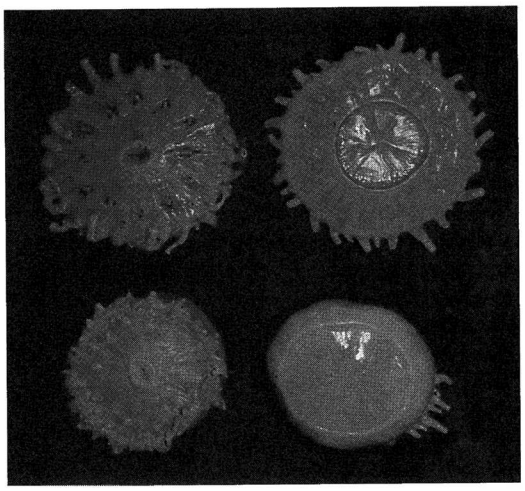

FIGURE 1. *Corallimorphus denhartogi*, n. sp. *Top:* Specimens in which the pedal disk diameter is less than half that of the oral disk (specimen at left is paratype MLML C 0193; the greatest diameter of its oral disk is 42 mm). *Bottom:* Specimens in which the pedal disk diameter is more than half that of the oral disk.

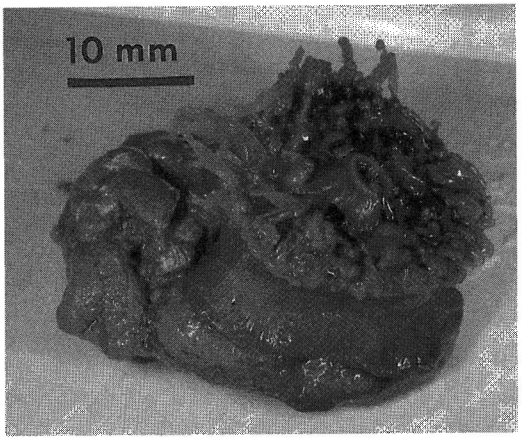

FIGURE 2. Holotype of *Corallimorphus pilatus*, n. sp. (RBCM 001-0044-001).

ably smaller than *C. denhartogi*, they have relatively long and densely arrayed tentacles. Specimens of *C. pilatus* have been displayed alive at the Monterey Bay Aquarium.

Seven species have been described in the genus *Corallimorphus* (Fautin 2001). They are *C. profundus* Mosley, 1877 (type species); *C. rigidus* Mosley, 1877; *C. obtectus* Hertwig, 1888; *C. ingens* Gravier, 1918; *C. stephensoni* Carlgren, 1928; *C. antarcticus* Carlgren & Stephenson, 1929; and *C. atlanticus* Carlgren, 1934. In his catalog of sea anemones of the world, Carlgren (1949) recognized six species; he questionably synonymized *C. stephensoni* with *C. ingens*, and also synonymized *Isocorallium hertwigi* Carlgren, 1900, with *C. rigidus*. One of us (Fautin 1984) subsequently reduced that number to four by synonymizing *C. antarcticus* with *C. profundus*, and *C. obtectus* with *C. rigidus*. Specimens of the genus *Corallimorphus* may be obtained in poor condition, and developmental abnormalities are common (Fautin 1984). Both these factors have contributed to taxonomic confusion and the creation of more names than is warranted.

The species of *Corallimorphus* can be divided into two groups based on tentacle number: a member of the *rigidus* group has about twice as many marginal as discal tentacles, whereas a member of the *profundus* group has about four times as many marginal as discal tentacles. *Corallimorphus denhartogi* belongs to the *rigidus* group, and *C. pilatus* belongs to the *profundus* group. One of us (Fautin 1984) and den Hartog et al. (1993) summarized opinions about the significance of tentacle number in *Corallimorphus*.

The two previously known species that had been recorded from the Pacific are *C. profundus* and *C. rigidus*. The known distribution of *C. profundus* is south of 33° 42′ S in the South Pacific, and around Antarctica except between 38° W and 93° E, at depths from 42 to 3702 m (summarized by Fautin 1984). *Corallimorphus rigidus* has a more northerly distribution, from 31° N off Japan, south through Indonesia and the South Pacific to 60° S, from nearly 7° N in the Indian Ocean to the Great Australian Bight, and off both sides of southern South America, at depths from 245 to 4429 m (summarized by Fautin 1984).

MATERIALS AND METHODS

Some of the approximately 500 specimens of *Corallimorphus denhartogi* we studied were trawled by K. L. Smith Jr. from 220 km off

the coast of California, at 34° 50′ N, 123° 00′ W, and 4100 m (fig. 1 in Lauerman et al. 1996); they are now part of the collection of the University of Kansas Natural History Museum (KUNHM), Lawrence, Kansas. Some were trawled by A. G. Carey Jr. from stations approximately 1200 km off the coast of Oregon, centered around 45° N, 135° W, at 3700–3900 m; they are now part of the collection of the Santa Barbara Museum of Natural History (SBMNH), Santa Barbara, California. These animals came from some of the same collections as anemones studied by White et al. (1999). Specimens from southern California and Baja California are part of the collection of the Scripps Institution of Oceanography (SIO), La Jolla, California. Specimens of *Corallimorphus pilatus* collected by employees of the Monterey Bay Aquarium and the Monterey Bay Aquarium Research Institute in Monterey Bay and Monterey Canyon, California, are deposited in the KUNHM. We also examined specimens from waters of British Columbia that are in the collection of the Royal British Columbia Museum (RBCM), Victoria, British Columbia, Canada; from off central California that are in the collection of the Moss Landing Marine Laboratory (MLML); and from off southern California that are in the SIO collection.

Immediately after collection, some specimens were fixed in 10% buffered formalin and were later transferred to 70% EtOH; others were preserved immediately in 70% EtOH.

For histological study, paraffin sections 8 μm thick were stained with hematoxylin and eosin (Humason 1979). Cnidae from mesenterial filaments, actinopharynx, tentacle base, acrosphere, and column were observed with differential interference contrast optics in squash preparations; measurements are of undischarged capsules. Not all tissues were studied in all animals.

In addition to institutions mentioned above, the California Academy of Sciences (CAS), San Francisco, California; the Rijksmuseum van Natuurlijke Historie (RMNH), Leiden, the Netherlands; and the U.S. National Museum of Natural History (USNM), Washington, D.C., hold type specimens.

Corallimorphus denhartogi Fautin, White & Pearson, n. sp.
Figures 1, 3, 4, 5, 6

BODY FORM AND SIZE: Discoidal. Oral disk 5–70 mm diameter; pedal disk circular, 5–65 mm diameter; height 3–28 mm. Superficially divisible into two groups: those in which pedal disk diameter less than half that of oral disk (Figure 1, *top*) and those in which pedal disk diameter more than half that of oral disk (Figure 1, *bottom*). Animals of the two types occur together and do not differ otherwise.

Ectoderm commonly absent (Figure 3); if present, typically trapped in longitudinal furrows of column or radial furrows of oral disk and around base of tentacles. Yellowish color; hyaline in appearance, presumably because of exposed mesoglea; remnants of ectoderm yellow, violet, or brown (Figure 1, *top left*).

ORAL DISK AND TENTACLES: Oral disk circular, flat or slightly domed, commonly raised around mouth that is slitlike to ovoid;

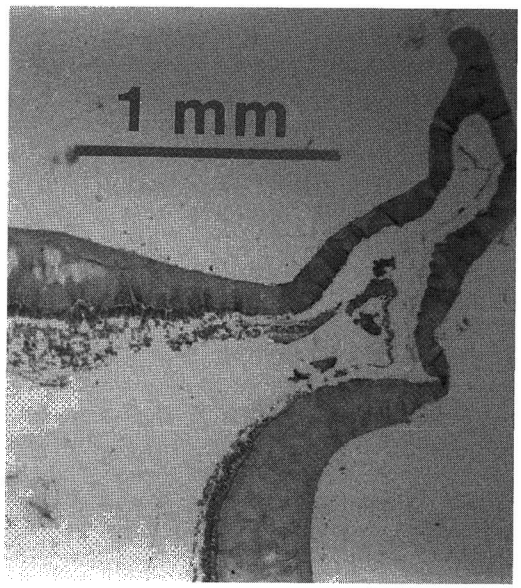

FIGURE 3. Longitudinal section at margin of *Corallimorphus denhartogi*, n. sp. (holotype: KUNHM 001391). Note absence of sphincter muscle, taper of acellular mesoglea, and absence of ectoderm.

TABLE 1

Dimensions (mm) of Marginal Tentacles in Three Specimens of *Corallimorphus denhartogi*

Oral Disk Diameter	Primary Marginal Tentacle				Exocoelic Tentacle			
	Length	Basal Diameter	Diameter below Acrosphere	Acrosphere Diameter	Length	Basal Diameter	Diameter below Acrosphere	Acrosphere Diameter
50	7	5	1.5	2	3	2	Nearly 1	1
33	7	2	Nearly 1	1	2	1	Nearly 0.5	0.5
15	4.5	1	Nearly 1	1	1	<0.5	<0.5	<0.5

mouth as much as a third oral disk diameter; distalmost portion of yellow, rugose actinopharynx commonly visible, shallow furrows may radiate from mouth. Tentacles sparse, so disk easily visible (Figure 1). Mesenterial insertions visible as dark or light lines through disk especially around mouth. Marginal tentacles alternately large and small, radiating from or oriented perpendicular to oral disk plane.

Tentacles tapered, capitate; rare ones bifurcate; acrospheres break off easily. Marginal tentacles larger than discal; see Table 1 for dimensions of marginal tentacles. Some tentacles mere nubbins (i.e., less than 1 mm long).

One marginal tentacle communicates with each exocoel and endocoel, one discal tentacle communicates with each endocoel, so predominant ratio of marginal:discal tentacles 2:1 (Figure 4); rarely more than two tentacles communicate with an endocoel. Number of marginal tentacles 35–51, modal number 48 in 110 specimens in which they were counted. Irregularities common: for example, two exocoelic tentacles between a primary and tertiary tentacle, two sets of tertiary tentacles (alternating with exocoelic tentacles) between a primary and a secondary one. Modal number of discal tentacles 24, range 0–33 in the 110 specimens. Entire tentacle can break off, which may account for some low numbers, but most variability probably real. Discal tentacles in cycles: the 6 largest, which communicate with primary endocoels, nearest mouth; the 6 communicating with secondary endocoels slightly smaller and slightly nearer margin; the 12 communicating with tertiary endocoels nearest margin and smallest. This arrangement diagrammed in fig. 50*E* of den Hartog et al. (1993).

COLUMN: Smooth; mesenterial insertions visible through it as dark lines. Shallow longitudinal furrows that may retain ectoderm few, irregular; do not correspond in position to mesenterial insertions.

PEDAL DISK: Flat to slightly concave; limbus extends below it in most individuals, turned under in some. Mesenterial insertions visible through it as dark or light lines.

MESENTERIES AND INTERNAL ANATOMY: Internal structures commonly poorly preserved. Typically 24 pairs of mesenteries, 12 pairs (primaries and secondaries) complete, directive mesenteries not distinguishable. Retractor muscles indistinct (Figure 5); parietobasilar muscles absent. All mesenteries fertile (Figure 5): sexes separate, eggs yellow to 1 mm diameter in preservation.

Actinopharynx deeply sulcate, without siphonoglyphs; ectoderm of actinopharynx commonly sloughed off.

Marginal sphincter muscle absent (Figure 3).

Mesoglea acellular, transparent, can be thick; with fibers between ectoderm and endoderm, and scattered holes in fixed material (Figure 3). Typically, mesoglea of oral disk tapers toward mouth and margin (Figure 3) so thickest halfway across or near margin: to 2 mm thick in individuals 33 and 45 mm oral disk diameter, 3 mm thick in one 48 mm diameter, but 0.5 mm thick in another 33 mm diameter. Mesoglea of column may taper at

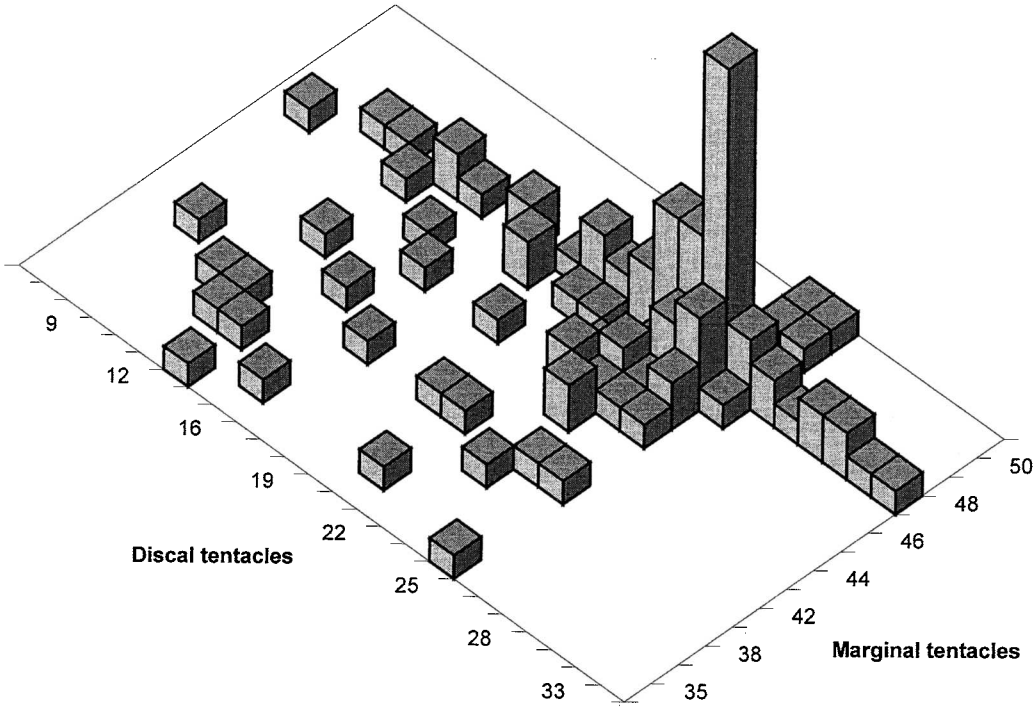

FIGURE 4. Number of marginal and discal tentacles in 110 specimens of *Corallimorphus denhartogi*, n. sp. The longest bar represents 14 individuals with 48 marginal and 24 discal tentacles; each of the two bars to its left represents six individuals; and each of the lowest bars (of which there are 46) represents a single individual.

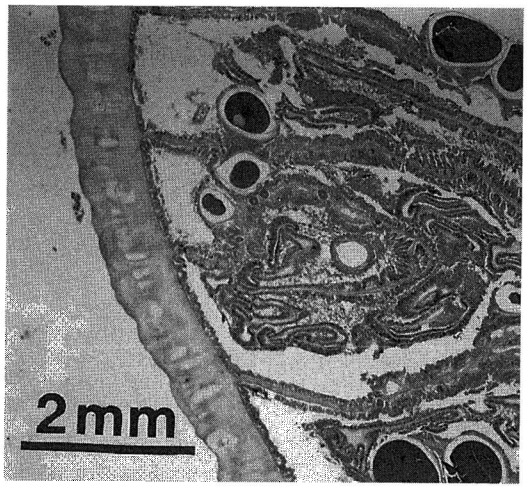

FIGURE 5. Cross section through midcolumn of *Corallimorphus denhartogi*, n. sp. (holotype: KUNHM 001391). Note thickness of acellular mesoglea, holes in mesoglea, absence of ectoderm, and shallowness and irregularity of longitudinal furrows.

margin and limbus with mesoglea thickest just proximal to margin (nearly 2 mm in animal with oral disk diameter 30 mm), or at limbus.

CNIDOME: Spirocysts, basitrichs, microbasic *p*-mastigophores, microbasic *b*-mastigophores, and holotrichs.

Size and distribution of cnidae given in Table 2, illustrated in Figure 6. Erosion of tentacle ectoderm in most individuals may be responsible for the small numbers of cnidae of some types found in some individuals.

ETYMOLOGY: This species is named in honor of J. C. den Hartog (1942–2000), a naturalist who was a taxonomic authority on corallimorpharians, and who was a curator at the Rijksmuseum van Natuurlijke Historie, Leiden.

TYPE SPECIMENS: See Table 3. Histological slides were made from most type specimens.

TABLE 2

Cnidae of *Corallimorphus denhartogi* (Letters in Parentheses Refer to Illustrations in Figure 6)

Character	Measurements	
Marginal tentacle acrosphere		
Spirocyst (*a*)	33.1–74.6 × 3.1–7.4	$n = 17$, $N = 4/8$
Holotrich (*b*)	29.8–63.2 × 4.6–12.8	$n = 54$, $N = 7/8$
Hoplotelic microbasic *b*-mastigophore (*c*)	11.1–34.1 × 4.2–8.2	$n = 103$, $N = 8/8$
*Holotrich	12.0–26.7 × 7.4–12.8	$n = 10$, $N = 1/8$
*Holotrich	164.0–221.4 × 16.4–27.5	$n = 6$, $N = 1/8$
*Microbasic *p*-mastigophore	105.2–191.5 × 6.7–10.7	$n = 13$, $N = 2/8$
Base of discal tentacle		
Spirocyst (*a*)	(12.3) 18.4–47.0 × 2.3–6.2	$n = 40$, $N = 6/8$
Microbasic *p*-mastigophore (*d*)	16.6–32.0 × 5.2–9.0	$n = 41$, $N = 6/8$
Hoplotelic microbasic *b*-mastigophore (*c*)	14.1–26.2 × 4.5–7.9	$n = 68$, $N = 7/8$
Actinopharynx		
Holotrich (*e*)	66.7–115.9 × 10.4–29.7	$n = 87$, $N = 10/10$
Hoplotelic microbasic *b*-mastigophore (*f*)	42.2–90.5 × 9.7–18.6	$n = 113$, $N = 10/10$
Mesenterial filaments		
Holotrich (*b*)	22.6–61.1 × (4.4) 6.3–13.8	$n = 27$, $N = 6/11$
Holotrich (*e*)	61.2–123.4 × 11.6–26.2	$n = 100$, $N = 10/11$
Hoplotelic microbasic *p*-mastigophore (*g*)	43.1–102.6 × 5.8–12.2	$n = 79$, $N = 8/11$
Hoplotelic microbasic *b*-mastigophore (*c*)	13.3–25.0 × 3.5–8.1	$n = 114$, $N = 10/11$
Hoplotelic microbasic *b*-mastigophore (*f*) (inferred to be a contaminant from the actinopharynx)	37.8–75.6 × 10.8–15.3	$n = 40$, $N = 5/11$
Column		
Hoplotelic microbasic *p*-mastigophore (*d*)	16.7–36.0 × 5.9–9.6	$n = 36$, $N = 4/4$
Hoplotelic microbasic *b*-mastigophore (*c*)	13.7–23.7 × 4.5–7.5	$n = 22$, $N = 3/4$

Note: Measurements are ranges first of length, followed by width, in μm. Numbers in parentheses are of single capsules that fell outside the typical range; *n* is the number of capsules measured, and *N* is the number of specimens in which that type of cnida occurred relative to the number in which the tissue was examined. Asterisks indicate cnidae that were found in only one or two individuals in small numbers. They are not illustrated because they could not be relocated for photography, but we include them because they were found in ectoderm, which is patchy in these animals, and they were sufficiently abundant that they are unlikely to be contaminants.

Corallimorphus pilatus Fautin, White & Pearson, n. sp.
Figures 2, 7, 8, 9

BODY FORM AND SIZE: Cylindrical: oral and pedal disks of similar size or one slightly larger than other. Oral disk in preserved specimens studied circular to ovoid, 2–35 mm diameter; pedal disk circular, 2.5–35 mm diameter; height 3–20 mm. In living specimens, diameter to 60 mm and height to 40 mm. Yellowish ectoderm present only in patches on column of preserved specimens; brownish ectoderm on oral disk around tentacles and at base of tentacles of some specimens; tentacle acrospheres white. Otherwise animal yellowish or pinkish; hyaline in appearance, presumably because of exposed mesoglea. Column of some living individuals translucent to nearly transparent, others uniform purplish; tentacles opaque white.

ORAL DISK AND TENTACLES: Oral disk commonly raised around mouth. Mouth typically a slit a quarter to a third oral disk diameter; tan in live or recently preserved animals. Longitudinal corrugations of actinopharynx visible at mouth opening. Due to length and number, tentacles obscure most of oral disk (Figure 2).

Tentacles tapered, capitate, longitudinally furrowed; rare ones bifurcate. Those arising from disk slightly longer than disk radius: 15 mm in animal of 25 mm diameter, 17 mm in animal of 35 mm diameter. Tentacle 15 mm long had basal diameter 2 mm and acrosphere 1 mm diameter. Marginal tentacles to about

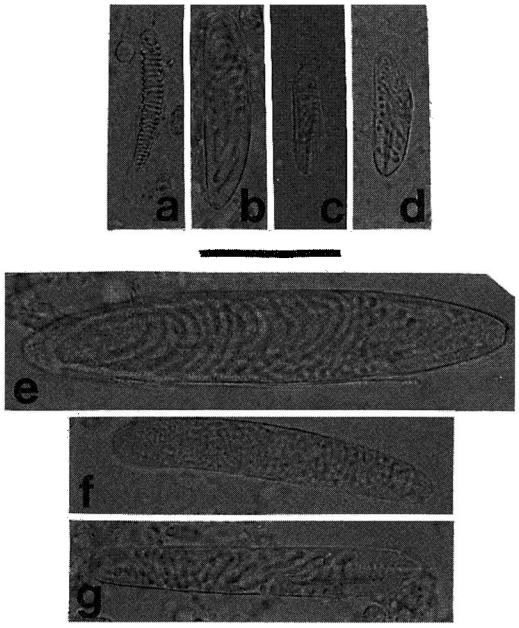

FIGURE 6. Nematocysts of *Corallimorphus denhartogi*, n. sp. Scale bar represents 30 μm. See Table 2 for explanation.

one-third length of discal ones and 1 mm basal diameter, but may be mere nubbins. In a live individual 60 mm diameter, largest tentacle 15 mm long; smallest tentacle 5 mm long, diameter slightly more than 1 mm at base and acrosphere.

Tentacles difficult to count: discal tentacles concentrated near margin, which may be flared. Ideal ratio 4:1 marginal:discal tentacles (96 marginal = 6 primary, 6 secondary, 12 tertiary, and 24 fourth-order endocoelic ones, plus 48 exocoelic ones; 24 discal = one communicating with each primary, secondary, and tertiary endocoel). Commonly ratio nearer 2.6–3:1, presumably due to delayed growth of some fourth-order tentacles and broken or rudimentary ones.

COLUMN: Distalmost end flared in some individuals. Shallow longitudinal furrows numerous, regularly spaced, giving cross sections of scalloped appearance (Figure 7); furrows retain ectoderm, do not correspond in position to mesenterial insertions, which may be visible through smooth column as light lines.

TABLE 3

Type and Voucher Specimens of *Corallimorphus denhartogi*

Institution	Status	Catalog No.	Locality	Depth (m)	No. of Specimens
KUNHM	Holotype	001391	34° 43′ N, 123° 11′ W	4,100	1
	Paratypes	001528	36° 15.94′ N, 122° 36.66′ W	2,820–2,960	4
CAS	Paratype	146043	34° 42′ N, 123° 09′ W	4,100	1
	Paratype	154362	37° 04.44′ N, 123° 24.40′ W	3,175–3,180	1
MLML	Paratype	C 0193	37° 38.62′ N, 123° 28.03′ W	2,945–?3,075	1
RBCM	Paratype	001-0046-001	34° 40′ N, 123° 11′ W	4,100	1
RMNH	Paratype	Coel. 24967	34° 47′ N, 123° 07′ W	4,134	1
SBMNH	Paratypes	144410	44° 43′ 18″ N, 127° 22′ 48″ W	3,021	2
	Paratype	144411	Mendocino County, California; S of Mendocino Ridge, W of Delgado Fan	4,250	1
SIO	Paratype	Co 1388	31° 24′ N, 120° 14.5′ W–31° 28.2′ N, 120° 10.3′ W	3,880	1
	Vouchers	Co 2001	37° 22′ N, 123° 54′ W–37° 16′ N, 123° 53′ W	3,592–3,798	3
USNM	Paratype	100903	34° 44′ N, 123° 07′ W	4,100	1
	Paratypes	1000047	37° 38.53′ N, 123° 29.23′ W	2,975–3,010	2

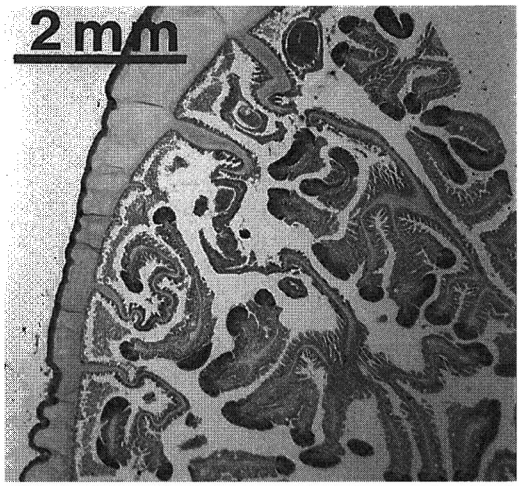

FIGURE 7. Cross section through midcolumn of *Corallimorphus pilatus*, n. sp. (holotype: RBCM 001-0044-001). Note thickness of mesoglea, and ectoderm in shallow, regularly spaced longitudinal furrows.

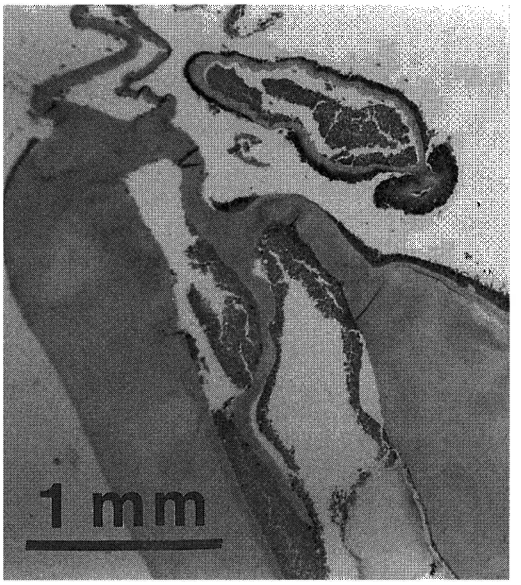

FIGURE 8. Longitudinal section at margin of *Corallimorphus pilatus*, n. sp. (holotype: RBCM 001-0044-001). Note absence of sphincter muscle, taper of mesoglea, and nuclei in mesoglea (especially at the margin).

PEDAL DISK: Flat or concave; most specimens studied adherent to stones or shells. Mesenterial insertions not visible through the disk.

MESENTERIES AND INTERNAL ANATOMY: Internal structures commonly poorly preserved. Typically 24 pairs of mesenteries, 12 pairs (primaries and secondaries) complete, directive mesenteries not distinguishable. Retractor muscles indistinct (Figure 7); parietobasilar muscles absent. All mesenteries fertile (Figure 7): sexes separate, eggs yellow to 1 mm diameter in preservation.

Actinopharynx rugose, lacking siphonoglyphs; partly or completely brown in specimens examined.

Marginal sphincter muscle absent (Figure 8).

Mesoglea transparent, thick, with sparsely scattered small nuclei (Figure 8). Typically tapers toward mouth and margin (Figure 8) so thickest halfway across oral disk. Mesoglea of column tapers at margin and limbus with mesoglea thickest halfway between.

CNIDOME: Spirocysts, basitrichs, microbasic *p*-mastigophores, microbasic *b*-mastigophores, and holotrichs.

Size and distribution of cnidae given in Table 4, illustrated in Figure 9.

ETYMOLOGY: The name "pilatus," which is in the nominative singular and is masculine, means thick or dense in reference to hair. The name refers to the density of tentacles relative to the coverage in *C. denhartogi.*

NATURAL HISTORY: Judging by the presence of small individuals surrounding a large one in two samples, animals of this species may reproduce asexually by means of pedal laceration. Eggs were seen free in the gastrovascular cavity; they may move into tentacles. We found unfired hydrozoan nematocysts in squash preparations of mesenterial filaments from two specimens; we therefore infer that individuals of *C. pilatus* eat hydrozoans. One of the paratypes from lot SIO Co 2009 was attached to the shell of a bivalve and the other was attached to the shell of a brachiopod.

TYPE SPECIMENS: See Table 5. Histological slides were made from most type specimens.

TABLE 4

Cnidae of *Corallimorphus pilatus* (Letters in Parentheses Refer to Illustrations in Figure 9)

Character	Measurements	
Marginal tentacle acrosphere		
Spirocyst (*a*)	25.5–68.7 × 2.0–5.3	$n = 17, N = 3/4$
Holotrich (*b*)	19.9–43.1 × 5.8–12.6	$n = 11, N = 3/4$
Holotrich (*c*)	91.1–161.4 × 7.9–16.1	$n = 14, N = 2/4$
Hoplotelic microbasic *p*-mastigophore (*d*)	80.3–155.3 × 4.9–9.9	$n = 13, N = 2/4$
Hoplotelic microbasic *b*-mastigophore (*e*)	7.7–27.6 × 2.9–6.7	$n = 28, N = 4/4$
Hoplotelic microbasic *b*-mastigophore (*f*)	25.3–106.7 × 1.9–7.4	$n = 33, N = 3/4$
Base of discal tentacle		
Spirocyst (*a*)	16.7–31.3 × 2.7–5.5	$n = 11, N = 3/4$
Hoplotelic microbasic *p*-mastigophore (*g*)	9.9–29.1 × 3.2–7.5	$n = 36, N = 4/4$
Hoplotelic microbasic *b*-mastigophore (*h*)	6.3–11.2 × 2.4–4.6	$n = 10, N = 1/4$
Actinopharynx		
Holotrich (*i*)	20.9–57.5 × 5.0–13.9	$n = 42, N = 4/4$
Mesenterial filaments		
Holotrich (*b*)	34.8–89.7 × 8.2–21.4	$n = 44, N = 4/4$
Hoplotelic microbasic *p*-mastigophore (*g*)	19.3–66.4 × 4.3–11.4	$n = 34, N = 4/4$
Hoplotelic microbasic *b*-mastigophore (*f*)	8.3–25.7 × 4.0–6.7	$n = 13, N = 3/4$
Column		
Hoplotelic microbasic *p*-mastigophore (*g*)	12.3–28.0 × 3.2–8.9	$n = 41, N = 4/4$
Hoplotelic microbasic *b*-mastigophore (*h*)	4.9–21.5 × 2.0–6.1	$n = 29, N = 4/4$

Note: Measurements are ranges first of length, followed by width, in μm. Numbers in parentheses are of single capsules that fell outside the typical range; *n* is the number of capsules measured, and *N* is the number of specimens in which that type of cnida occurred relative to the number in which the tissue was examined.

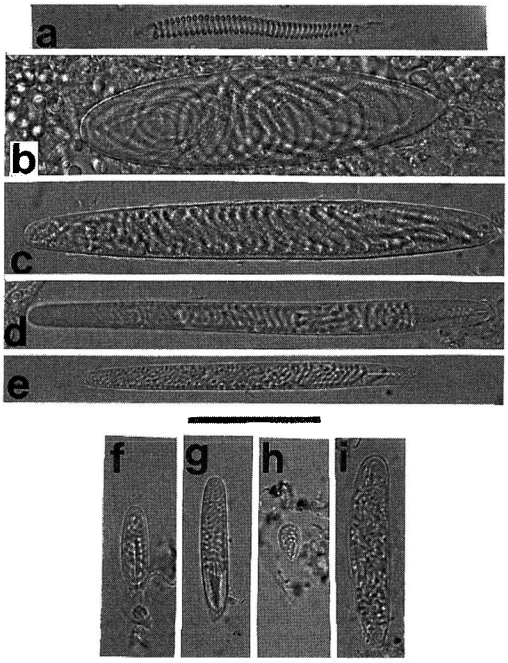

FIGURE 9. Nematocysts of *Corallimorphus pilatus*, n. sp. Scale bar represents 30 μm. See Table 4 for explanation.

DIFFERENTIAL DIAGNOSIS

The two new species we describe, *Corallimorphus denhartogi* and *C. pilatus*, can be distinguished from one another on several grounds. The former has very short tentacles and a relatively expansive oral disk that is not obscured by the tentacles arising from and around it, whereas the relatively long tentacles of *C. pilatus* may obscure the oral disk. The definitive ratio of marginal:discal tentacles is 2:1 in *C. denhartogi*, and 4:1 in *C. pilatus*, although this feature can vary, and at the penultimate stage of development, *C. pilatus* has only twice as many marginal as discal tentacles. Compared with that of *C. denhartogi*, the column of *C. pilatus* is relatively longer, is more cylindrical, and has more numerous longitudinal furrows that are more regularly spaced. There are differences in nematocysts: for example, hoplotelic microbasic *b*-mastigophores are present in the actinopharynx of *C. denhartogi* but absent in *C. pilatus*. There are also size differences: for example, the mesenterial filaments of *C.*

TABLE 5

Type and Voucher Specimens of *Corallimorphus pilatus*

Institution	Status	Catalog No.	Locality	Depth (m)	No. of Specimens
RBCM	Holotype	001-0044-001	48° 53.1′ N, 126° 54.5′ W	900	1
	Paratype	988-258-8	48° 25.6′ N, 126° 08.6′ W	315	1
	Vouchers	988-268-34	48° 53.1′ N, 126° 54.5′ W	900	7
CAS	Paratype	152514	48° 53.1′ N, 126° 54.5′ W	900	1
KUNHM	Paratype	001392	36° 45.32′ N, 121° 58.26′ W	490	1
	Paratype	001393	36° 45.32′ N, 121° 58.26′ W	490	1
	Paratype	001394	48° 53.1′ N, 126° 54.5′ W	900	1
SBMNH	Paratypes	144409	45° 52′ 42″ N, 124° 53′ 48″ W	840	2
SIO	Paratypes	Co 2009	32° 55.5′ N, 117° 37.4′ W–32° 51.0′ N, 117° 36.0′ W	896	2
USNM	Paratype	100904	48° 53.1′ N, 126° 54.5′ W	900	1

denhartogi have holotrichs of two size classes whereas in *C. pilatus* there is a single class of intermediate size. Typically, scattered in the mesoglea of *C. denhartogi* are large holes and in that of *C. pilatus* are small nuclei. Individuals of *C. denhartogi* have been collected from deeper water than those of *C. pilatus* and have a wider bathymetric range.

Corallimorphus denhartogi, having a 2:1 marginal:discal tentacle ratio, belongs to the *rigidus* group. A typical specimen of *C. rigidus* is larger than one of *C. denhartogi* and its tentacles are more robust, especially at the margin. The cnidae of *C. rigidus* are incompletely known (Fautin 1984): the holotrichs of the actinopharynx are of similar size in the two species. The other certain member of the group is *C. ingens*. The haplotelic microbasic *p*-mastigophores of its column, called penicilli D by den Hartog et al. (1993), are of similar size to those of *C. denhartogi*, but its actinopharynx has only holotrichs, called homotrichs by den Hartog et al. (1993), and they are smaller than those of *C. denhartogi*. Holotrichs are also present in the actinopharynx of *C. denhartogi* but are absent in *C. ingens*. Moreover, *C. ingens* is known only from the Atlantic and, compared with *C. denhartogi*, is more cylindrical and has much longer marginal tentacles (den Hartog et al. 1993). *Corallimorphus atlanticus*, which may be synonymous with *C. rigidus* (see Fautin 1984), has haplotelic microbasic *b*-mastigophores of two size categories in its mesenterial filaments, both of which are larger than those of *C. denhartogi*, and is also known only from the Atlantic (den Hartog et al. 1993).

With a 4:1 marginal:discal tentacle ratio, *C. pilatus* belongs to the *profundus* group, the only other member of which is *C. profundus*, which is known from south of 33° S (Fautin 1984). The body and tentacle form of *C. pilatus* and *C. profundus* are similar; *C. profundus* is typically larger. The two differ in cnidae: holotrichs of the acrospheres of *C. profundus* are much larger than those of *C. pilatus*, and the actinopharynx of *C. profundus* contains only holotrichs.

The cnidae of *C. denhartogi* differ from those of *C. profundus*, and the cnidae of *C. pilatus* differ from those of *C. rigidus*.

DISCUSSION

The two new species described here are typical of the genus *Corallimorphus* in morphological respects, such as the absence and poor development of sphincter and retractor muscles, respectively. As is characteristic of the genus, specimens are typically poorly preserved. Nonetheless, they are distinct from the species of the genus currently recognized (Fautin 1984).

There is a clear mode of 24 discal and 48 marginal tentacles in *C. denhartogi* (Figure 1). The number of discal tentacles declines

sharply above 24 but rises gradually to 24 (Figure 4), from which we infer that 24 represents the definitive number. Not uncommonly, two discal tentacles arise side by side from an endocoel; this observation is further evidence (e.g., Fautin 1984, den Hartog et al. 1993) that supernumerary tentacles may result from developmental abnormalities in corallimorpharians. Fewer than 24 discal tentacles may be due to one or both of two causes: damage can remove tentacles, and, if the animal was collected before it was fully mature, all of its tentacles might not have formed. Two pieces of evidence support ontogeny being part of the explanation for fewer than 24 discal tentacles: the low-amplitude mode around 12 discal tentacles, and the fact that in those individuals, the tentacles communicate exclusively with the primary and secondary endocoels.

The arrangement of tentacles is less clear in *C. pilatus* because we had fewer specimens to examine and because of the more numerous tentacles of smaller animals. Preceding development of the ultimate cycle of mesenteries, an individual may have 48 marginal and 24 discal tentacles, as did one of the specimens we examined. The other specimens, however, had many more marginal and no more discal tentacles, despite being smaller than most of those of *C. denhartogi* we examined, which makes us confident that the difference in tentacle ratio we observed between the two species is not due to ontogeny.

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